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(54) PRODUCTION OF WHOLE GRAIN SOYBEAN MILK

(57) Abstract:

PURPOSE: To obtain the whole grain soybean milk, drinkable easily without a sandy incompatible feeling in eating, and capable of giving smooth bean curd, by pulverizing finely the whole grain soybeans, skinned soybeans or defatted soybeans by the dry method, and dispersing or dissolving the resultant fine powder in water.

CONSTITUTION: The whole grain soybeans, skinned soybeans or defatted soybeans are finely pulverized in a pin bill, etc. to give ≤20μ particle diameter of most the powder by the dry method. The resultant fine powder is then dispersed or dissolved in water to afford an aqueous dispersion or solution of the fine soybean powder, which is heat-treated to give the whole grain soybean milk. The heat treatment can be preferably carried out by a direct heating method of injecting

pressurized steam, and cooling the fine powder under reduced pressure to remove an offensive smell.

EFFECT: The soybean milk can be easily produced at a low cost.

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(54) Title of Invention: Manufacturing Method for Whole Soy Milk

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(22) Application: December 27, Showa 58 (1983)

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Description

1. Title of Invention
   Manufacturing Method for Whole Soy Milk
2. Scope of Patent Claims
   1 A manufacturing method for whole soy milk characterized by the diameter of the bulk of a soybean being pulverized to less than 20μ through dry milling of whole soybeans, or molted or defatted soybeans, and then dispersing and dissolving them in water following squeezing, and then heat treating the liquid of fine soy powder dispersed and dissolved in water thus obtained.
   2 A manufacturing method for whole soy milk as described in Patent Claim No. 1 in which heat treatment is performed after injecting pressurized steam through direct heating that decompression cools.
   3 A manufacturing method for whole soy milk as described in Patent Claim No. 1 in which homogenization is performed by using a homogenizer either before or after heat treatment.
3. Detailed Description of Invention

This invention concerns a manufacturing method for soy milk that includes fibers. Furthermore, going into detail, it is concerned with a manufacturing method for whole soy milk that liquidizes all of a whole soybean, or a molted or defatted soybean, without releasing the parts that are to be discarded.

In recent years, the interest in soy milk as a vegetable protein beverage that does not contain cholesterol has been on the rise, accompanying a shift in the demands of eating habits from consumption based on taste towards one based on health.

Broadly categorizing soy milks, it is possible to divide them into extracted types and whole types. However, the former is a type in which the dietary fiber known as Ocala is removed by crushing soybeans swelled by water absorption and extracting the proteins and fats, and the latter whole-type is one in which Ocala is refined without removal and included in the soy milk. In the former type which has Ocala removed, dietary fiber that is assumed to have great value in terms of nutrition and health is removed and discarded, while the latter whole type is said to be more desirable. However, because whole-type soy milk is conventionally manufactured through the grinding

down of raw soybeans by wet process, the methods for refining and forcibly dispersing the dietary fiber are technically inadequate, the milk has a strange rough sensation when consumed, and at this stage has yet to be put into practical use. In addition, the bulky fiber component negatively affects the structure of finished tofu in cases where tofu is made from this soy milk, and also has the drawback that the tofu produced always has a fragile and rough feeling on the tongue.

The inventors have conducted numerous earnest investigations into achieving a whole-type soy milk that can be used in tofu manufacture to make a smooth tofu, without the soy milk producing any strange sensations when consumed, and from their results, they have arrived at the title invention, which makes it possible to achieve a whole soy milk of superior quality by pulverizing the diameter of the bulk of a soybean to less than 20μ through dry milling of whole soybeans, or molted or defatted soybeans, and then dispersing and dissolving them in water following squeezing, and then heat treating.

The purpose of this invention is to provide a manufacturing method for whole-type soy milk that can be used to manufacture smooth tofu in cases where soy milk is used for tofu manufacturing and that can be easily consumed without any strange rough sensations when drunk.

The manufacturing method for whole soy milk in this invention is characterized by pulverizing the diameter of the bulk of a soybean to less than 20μ through dry milling of whole soybeans, or molted or defatted soybeans, and then dispersing and dissolving them in water following squeezing, and then heat treating.

This invention uses whole soybeans as they are, or molted or defatted soybeans. Although soybeans are dry pulverized, if pulverization is done by a method in which it is possible to make the diameter of the bulk of the soybean less than 20μ, it is therefore possible to use a method such as pin milling, without setting any particular limits. It is easier to perform pulverization when dry processing is done before pulverization, and it is also acceptable if a preliminary pulverization is performed. The degree of pulverization required is to make the diameter of the bulk of the soybean less than 20μ, and if it is any larger, then the finished soy milk will produce a rough feeling on the tongue when consumed, and it will not be possible to manufacture tofu with a good texture.

Pulverized soybeans are then dispersed and dissolved in water, obtaining a liquid of fine soy powder dispersed and dissolved in water. A mixture of soybeans and water in which the solidity of the solution is 5~35 weight% is acceptable. The liquid of fine soy powder dispersed and dissolved in water obtained in this manner is then transferred to the heat treating process.

With the process of dispersing and dissolving the pulverized soybeans in water and then heat treating, it is better if it is performed in as short a time as possible without the peculiar odor of soy milk being produced.

Although it is acceptable if the heat treatment is at a sufficient level to deactivate the ribo-oxidase that exists in the soybeans, it is desired that the heat treatment be performed by direct heating that decompression cools after injecting pressured steam, since the purpose is to remove the odor peculiar to soy milk, and to minimize the degeneration of the protein. Heat treatment via this kind of direct heating method is performed by using devices such as a uperization sterilizer (Albula), VTIA sterilizer (Alfa Laval), *Ragia*[?] UHT sterilizer (*Ragia*[?]), *Pararizeta*[?] (*Pashu ando Shirukepogu*[?]), or C.P.Vac-Heat/UHT pasteurizer (*Kurimari Pashikeji*[?]), operated at 130~155°C or 145~150°C for 2~10 seconds or 3.5~7 seconds.

After heating, the water in the solution is evaporated and cooled under low pressure. Although it is desirable for the degree of cooling to stop at 1~2°C higher than the temperature before steam injection for the purposes of preventing changes in the moisture, there is no particular limit.

In addition, although it is desirable that homogenization be done using a homogenizer such as a high-pressure homogenizer, centrifugal homogenizer, or ultrasonic homogenizer, before and/or after the heat treatment process, for the purposes of more finely dispersing the dietary fiber, the use of a high-pressure homogenizer is common, and the homogenization process is performed with the homogenization pressure over 200kg/cm^3 for results that are large, though 400~1000 kg/cm^3 is ideal.

The ideal mode for implementing this invention is described as follows.

Raw soybeans dried by a 45~55°C warm wind or hot blast of air undergo preliminary crushing by a cracking mill, then the diameter of the bulk of the soybean is crushed by a pulverizer so that it is less than 20μ (Ideally more than 98% of the diameters are less than 20μ), thus obtaining pulverized soybeans. Next, these are mixed with water so that they achieve 5~35% solidity. The mixture is heat treated using a direct heating-type sterilizer, and then is homogenized using

a high pressure-type homogenizer. Soy milk obtained in this manner is packed germ free and becomes product.

Through the method in this invention, it becomes possible to simply and inexpensively manufacture and provide whole soy milk that has the drawbacks of conventional whole soy milk, such as a strange rough sensation when consuming and the inability to manufacture smooth tofu, removed.

The following is a further detailed explanation of this invention with working examples provided.

Working Example 1

The diameter of the bulk of molted soybeans was crushed to less than 20μ with a Contraplex ultra-fine grinder (*Nishidoku*[?], *Arubine*[?]). Next, these were dispersed and dissolved in water so that 10% solidity was reached, then pasteurization heat treated for 5 seconds at 147°C with a direct heating-type ultra high temperature flah pasteurizer VTIS (Sweden Alfa Laval) after heating 40°C back and forth, and then undertook rapid decompression cooling to 70°C. Next, this was homogenized at a homogenization pressure of 200kg/cm^3 with a high pressure-type homogenizer, cooled 10°C back and forth with a plate-type cooler, and finally whole soy milk was obtained. This whole soy milk had a smooth taste, and a good flavor. Furthermore, when whole grain tofu was manufactured by heating this whole soy milk and adding 0.5% calcium sulfate according to standard procedure, a smoothly structured whole grain tofu was obtained.

Working Example 2

Crushed soybeans that had been dried 50°C back and forth by a hot air blast and then molted them with a Rotoplex course crusher (*Nishidoku*[?], *Arubine*[?]) so that the diameters were 2~4mm, and then crushed them with a Turbomill ultra fine grinder (Turbo Kogyo) so that the diameters of the bulk of the soybeans were less than 20μ.

Next, we dispersed and dissolved these in water so that 20% solidity was reached, and then pasteurized for 3.5 seconds at 150°C with a direct heating-type ultra high temperature flah pasteurizer VTIS (Sweden Alfa Laval), and then undertook rapid decompression cooling to 70°C. Next, whole soy milk was obtained by rapidly cooling this to 15°C with a plate-type cooler after homogenizing at a homogenization pressure of 500 kg/cm^3 with a high-pressure homogenizer.

When whole grain tofu was manufactured by heating this whole soy milk after diluting it with water to 10% solidity and adding 0.5% calcium sulfate according to standard procedure, a smoothly structured whole grain tofu was obtained. In addition, by diluting this whole soy milk with water to 10% solidity, a good flavor was achieved with a smooth feeling on the tongue and hardly any of the peculiar odors of soy milk.

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審査請求　未請求　発明の数 1　（全3頁）

㊹発明の名称　全粒豆乳の製造方法

㉑特　願　昭58－251017

㉒出　願　昭58(1983)12月27日

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明　細　書

1. 発明の名称

全粒豆乳の製造方法

2. 特許請求の範囲

1　丸大豆もしくは脱皮した大豆または脱脂大豆を乾式粉砕して大部分の粒径が20μ以下になるまで微粉砕し、しかる後に水に分散，溶解せしめ、得られた大豆微粉末水分散溶解液を加熱処理することを特徴とする全粒豆乳の製造方法。

2　加熱処理が加圧蒸気を注入した後、減圧冷却する直接加熱方式によつて行なわれる特許請求の範囲第1項記載の全粒豆乳の製造方法。

3　加熱処理の前および／または後にホモジナイザーを用いて均質化処理を行なう特許請求の範囲第1項記載の全粒豆乳の製造方法。

3. 発明の詳細な説明

本発明は繊維質を含んだ豆乳の製造法に関するものである。さらに詳しくは、丸大豆もしくは脱皮した大豆または脱脂大豆から廃棄する部分を出さず、全てを液状化してなる全粒豆乳の製造法に関するものである。

近年の食生活に対する要求の美食から健康への変遷に伴ない、コレステロールを含まない植物性蛋白飲料としての豆乳に対する関心が高まつてきている。

豆乳を大きく分類すると、抽出タイプと全粒タイプに分けられるが、前者は大豆を吸水膨潤させた後、砕いて蛋白質と脂肪を抽出し、オカラと称している繊維分を取り除いたタイプであり、後者の全粒タイプはオカラを取り除かず、微細化し、豆乳に含めたものである。前者のオカラを取り除いたタイプは栄養の面・健康の面からいえば非常に価値があるとされている繊維分を取り除いて廃棄してしまつており、後者の全粒タイプの方がより好ましいものと言える。しかしながら、従来この全粒タイプの豆乳は原料大豆を湿式法ですりつぶすことにより製造されているところから、その繊維分の微細化、強制分散の方法が技術的に十分なものではなく、

ザラザラとした飲用時の異和感があり、未だ実用化されていない現状にある。また、粗大な繊維成分は豆乳から豆腐を製造する場合、出来上つた豆腐の組織に悪い影響を与え、脆弱、かつザラザラとした舌ざわりの豆腐しか得られないという欠点を有していた。

本発明者らは飲用時に異和感がなく、しかも豆腐製造用に使用した場合、なめらかな豆腐を製造できる全粒タイプの豆乳を得るべく鋭意検討を重ねた結果、丸大豆もしくは脱皮した大豆、または脱脂大豆を乾式粉砕して大部分の粒径が20μ以下になるまで微粉砕し、しかる後に水に分散溶解させ、加熱処理することによつて優れた品質の全粒豆乳が得られることを見出し本発明に到達した。

本発明の目的は食用時にザラザラとした異和感がなく飲みやすく、しかも豆腐製造用の豆乳として使用した場合、なめらかな豆腐を製造できる全粒タイプの豆乳の製造方法を提供することにある。

本発明の全粒豆乳の製造方法は丸大豆もしくは脱皮した大豆または脱脂大豆を乾式粉砕して大部分の粒径が20μ以下になるまで微粉砕し、しかる後に水に分散，溶解せしめ得られた大豆微粉末水分散溶解液を加熱処理することを特徴とするものである。

本発明では丸大豆をそのままもしくは脱皮処理または脱脂したものを使用する。大豆は乾式にて微粉砕されるが、微粉砕は大部分の粒径が20μ以下になるようにすることができる方法なら特に限定する必要はなく、たとえばピンミルなどを用いることができる。微粉砕する前にあらかじめ乾燥処理を行うと微粉砕をより容易に行うことが出来、また予備粉砕処理を行つてもよい。微粉砕の程度は大部分の粒径が20μ以下になるようにする必要があり、それより大きくなると、できあがつた豆乳は飲用時ザラザラとした舌ざわりになり、豆腐を製造してもキメの良いものは得られない。

微粉砕した大豆を次いで水に分散，溶解せしめて、大豆微粉末水分散溶解液を得る。大豆と水は、溶解液中の固形分が5～35重量%となるように混合するのがよい。こうして得られた大豆微粉末水分散溶解液は加熱処理工程へ移される。

微粉砕した大豆を水に分散，溶解せしめて、加熱処理するまでの工程はできるだけ短時間に行なつた方が豆乳特有の青臭みの生成が少なく好ましい。

加熱処理は大豆中に存在しているリポオキシダーゼ等を不活性化するのに十分な程度であれば良いが、豆乳特有の青臭さ等異臭を除去し、かつ蛋白質の変性を少なくするという目的からは加熱処理は加圧蒸気を注入した後、減圧冷却する直接加熱方式によつて行うことが好ましい。このような直接加熱方式による加熱処理は、ユーペリゼーション殺菌装置（アルプラ社製），VTIS 殺菌装置（アルフアラバル社製），ラギアー UHT 殺菌装置（ラギアー社製），パラリゼーター（バッシュ・アンド・シルケボーグ社製），C.P.Vac-Heat・UHT 殺菌装置（クリマリイ・パッケージ社製）等の装置を用いて130～155℃、好ましくは145～150℃で2～10秒間、好ましくは3.5～7秒間処理することにより行なわれる。

加熱後、溶解液は減圧下で水分を蒸発させ冷却される。冷却の程度は水分の変化を防止する目的では蒸気注入前の温度より1～2℃高めまでにとどめるのが好ましいが、特に制限はない。

また、繊維分をより細かく分散させる目的で加熱処理工程の前及び／又は後で、高圧型ホモジナイザー，遠心式ホモジナイザー，超音波ホモジナイザー等のホモジナイザーを用いて均質化処理をすることが好ましいが、高圧型ホモジナイザーを用いるのが一般的で、その均質圧力は高いほど効果が大きく200 kg/cm² 以上、好ましくは400～1000 kg/cm² で均質化処理を行なう。

本発明の好ましい実施態様を以下に述べる。

45～55℃の温風又は熱風により乾燥した

大豆原料を粗粉砕機で予備的に粉砕し、次いで微粉砕機で大部分の粒径が20μ以下（好ましくは98%以上の粒径が20μ以下）になるまで粉砕し、微粉砕大豆を得る。次いでこれを固形分5～35%となるように水と混合する。混合液は、直接加熱方式の滅菌装置を用いて加熱処理され、さらに高圧型ホモジナイザーを用いて均質化される。このようにして得られた豆乳は、無菌的に包装され製品となる。

本願発明の方法によれば、飲用時のザラザラとした異和感及びなめらかな豆腐を製造できないといつた従来の全粒豆乳の欠点を解消した全粒豆乳を簡便にしかも安価に製造供給しうるものである。

以下に本発明の実施例をあげて本発明を更に詳しく説明する。

実施例1

脱皮した大豆を超微粉砕機コントラプレックス（西独，アルピネ社製）により大部分の粒径が20μ以下になるまで粉砕した。次いでこのものを固形分10%になるように水に分散溶解せしめ、40℃前後に加熱したのち直接加熱方式超高温瞬間殺菌機VTIS（スエーデンアルファラバル社製）によつて147℃5秒間殺菌処理し直ちに70℃まで減圧急冷した。ついでこのものを高圧型ホモジナイザーにて200kg/cm²の均質圧力で均質化し、プレート式冷却機を通し10℃前後まで急冷し、全粒豆乳を得た。

この全粒豆乳は、なめらかな舌触りを有し、かつ良好な風味を有していた。更にこの全粒豆乳を加温し常法に従つて硫酸カルシウム0.5%を加えて全粒豆腐を製造したところ、なめらかな組織の全粒豆腐が得られた。

実施例2

50℃前後の熱風にて乾燥し脱皮した大豆を粗粉砕機ロートプレックス（西独，アルピネ社製）によつて2～4mmの粒径に粉砕し、次いで超微粉砕機ターボミル（ターボ工業製）によつて大部分の粒径が20μ以下になるまで粉砕した。次いでこのものを固形分20%になるように水に分散溶解せしめ直接加熱方式超高温瞬間殺菌機VTIS（スエーデン，アルファラバル社製）によつて150℃3.5秒間殺菌処理し直ちに70℃まで減圧急冷した。次いでこのものを高圧ホモジナイザーで500kg/cm²の均質圧力で均質化したのちプレート式冷却機で15℃まで急冷し全粒豆乳を得た。

この全粒豆乳を1.0%の固形分になるように水で希釈したものを加温し常法に従つて硫酸カルシウム0.5%を加え全粒豆腐を製造したところ、なめらかな組織の全粒豆腐が得られた。またこの全粒豆乳を10%の固形分になるように水で希釈したものは、なめらかな舌ざわりをもち豆乳特有の青臭みも殆んどなく良好な風味をもつていた。

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